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ABSTRACT

As part of a series of tests to measure mastery of specific skills in the natural sciences, copies of tests 39 through 50 include: (39) using a code; (40) naming the parts of a microscope; (41) calculating density and predicting flotation; (42) estimating metric length; (43) using SI symbols; (44) using s=vt; (45) applying a novel theory; (46) calculating magnifications; (47) identifying trends in data; (48) calculating averages in practical situations; (49) applying a theory of genetics; and (50) multiplying in scientific notation. The multiple choice questions were written for students in grades 7 through 10. Teachers' notes and scoring information are provided for each test. (CM)

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M39

New South Wales **Department of Education**

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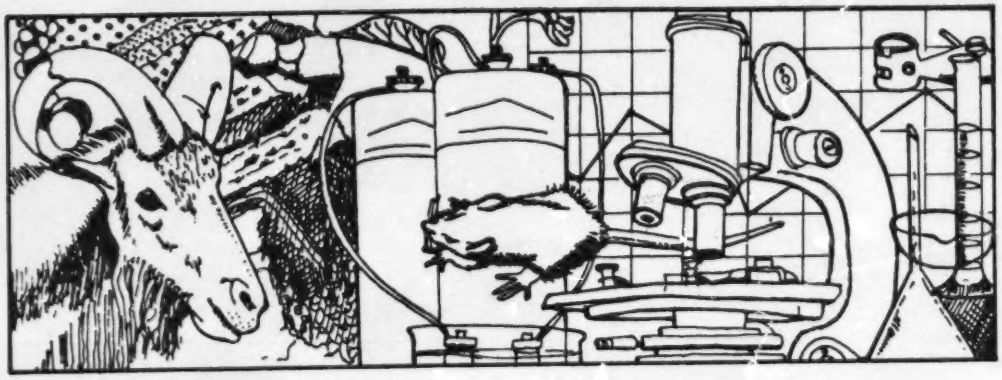
SCIENCE

MASTERY TESTING PROGRAMME



A MASTERY TEST FOR

THE SKILL OF USING A CODE (1)

TM 820 312

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
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This test is designed to measure your ability to use a code.
The code to be used is the Morse Code which is given below:

A ·−	F ··−·	K −·−	P ·−−·	U ··−
B −···	G −−·	L ·−··	Q −−·−	V ···−
C −·−·	H ····	M −−	R ·−·	W ·−−
D −··	I ··	N −·	S ···	X −··−
E ·	J ·−−−	O −−−	T −	Y −·−−
				Z −−··

For each question in this test, select the <u>correct</u> answer from among those given, and mark its letter (A, B, C or D) on your answer sheet.

<u>Set 1</u>. Which is the correct Morse Code symbol for the letter given?

Question	Letter	Symbol			
		A	B	C	D
1	F	−·−	·−··	·−·	··−·
2	M	−−	−·	·−··	··
3	S	−−−	···−	···	·−
4	U	···−	··−	−−	·−−
5	Y	−−·−	−·−−	−−··	−···−

Set 2.

Which is the correct Morse Code signal for the word given?

QUESTION	WORD	ANSWERS			
		A	B	C	D
6	Lid	−−.. ·· −−·	·−− ·· −−	·−·· ·· −··	··−· ·− ··
7	Ban	−−·· ·− −−	−··· −· ·−	−·−· ·− −·	·−−· ·− −·
8	Top	− −−−− ·−−·	−− − ·−−·	−−− − ·−−·	−− −−−− ··−·
9	Fed	··−· ·· −··	−−·· · ···	·−−· ·· ···	··−· · −··
10	Mug	−− ·· −·−·	−− ·−− −··	−−− ··− −··	−− ··− −−·

Set 3.

Which letter is represented by the Morse symbol shown?

QUESTION	SYMBOL	ANSWERS			
		A	B	C	D
11	−−·	G	M	N	W
12	−·−	K	P	R	X
13	−··	F	J	Q	W
14	−−··	L	P	R	X
15	···	H	I	S	V

Set 4.

Which word is a correct translation of the coded word?

QUESTION	CODE	A	B	C	D
16	−· · ·−− − −−− −·	Newton	Nestle	Newts	Newell
17	·−−· ··− ··· ····	Pull	Push	Pump	Pant
18	·−·· ·· −−· ···· −	Listen	Light	Legs	Ladle
19	·− −· −	And	All	Rat	Ant
20	·−− −−− ·−· −·−	Writ	Walk	Work	Worm

TEACHERS' NOTES

This test is designed to determine whether or not the student can use a code which they may be seeing for the first time.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as <80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1: Low scores here indicate problems in understanding the Morse code as it is supplied.

Set 2: This is a more complex form of Set 1.

Set 3: Low scores here indicate a basic problem with deciphering.

Set 4: This is a more complex form of Set 3.

Related tests: 021071 Using codes 2
021072 Using codes 3 (to be released as M64)

Related skills for which tests have not been prepared:

Constructing codes
Interpreting non-verbal codes

M40

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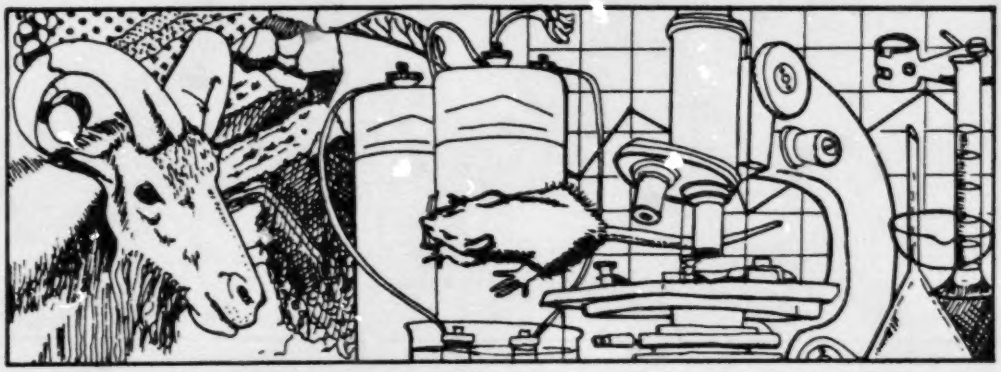
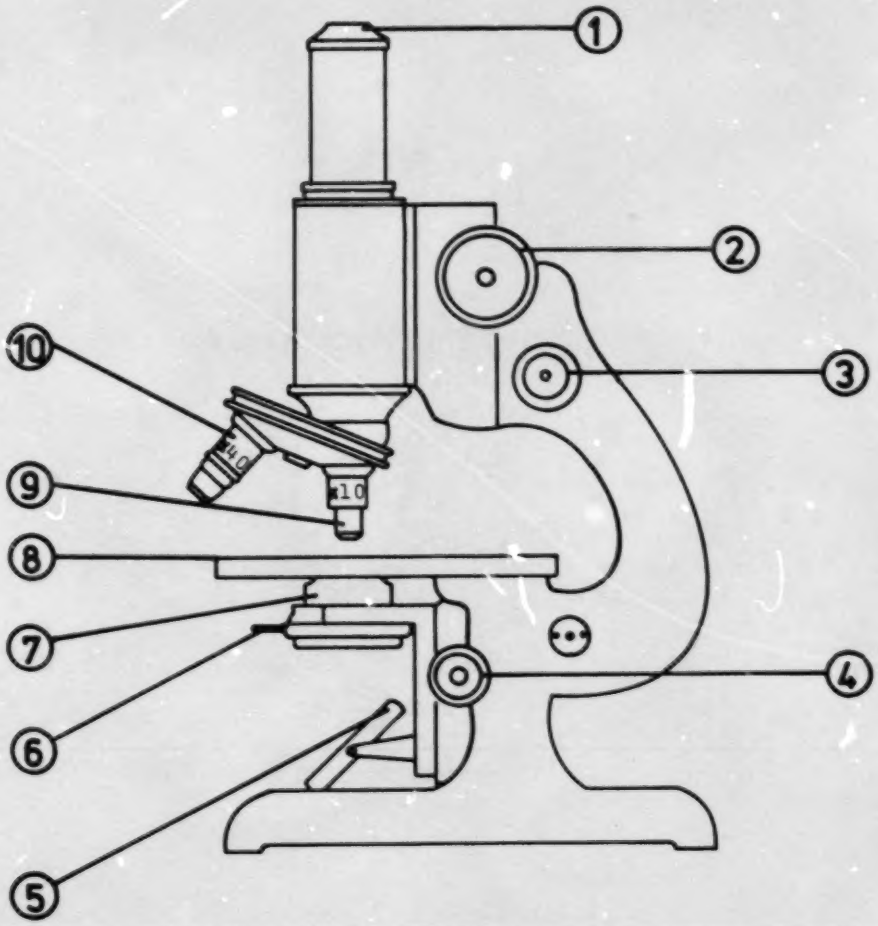


A MASTERY TEST FOR
THE SKILL OF
NAMING THE PARTS OF THE MICROSCOPE
AND IDENTIFYING THEIR FUNCTIONS

This test is designed to test your ability to name the parts of a microscope and identify their functions.

All questions in this test refer to this diagram:



SET 1

Select the *correct name* for each numbered part and mark its letter (A, B, C or D) on your answer sheet.

Question and part	ANSWERS			
	A	B	C	D
1	eye piece	focus knob	high power objective	low power objective
2	coarse focus control	condenser knob	fine focus control	hinge
3	coarse focus control	condenser knob	fine focus control	hinge
4	aperture control	condenser focus knob	diaphragm	mirror control
5	aperture control	condenser	diaphragm	mirror

SET 1 CONTINUED

Question and part	ANSWERS			
	A	B	C	D
6	condenser focus control	diaphragm control	mirror adjustment knob	stage
7	condenser	diaphragm	mirror	stage
8	aperture	condenser	diaphragm	stage
9	eye piece	high power objective	low power objective	nose piece
10	eye piece	high power objective	low power objective	nose piece

SET 2

Select the *correct function* for each numbered part and mark its letter (A, B, C or D) on your answer sheet.

Question	Part	ANSWERS			
		A	B	C	D
11	1	magnifies and focuses light	allows light onto the slide	adjusts focus	reduces brightness of light
12	2	adjusts "coarse" focus	adjusts high power objective	adjusts low power objective	adjusts "fine" focus
13	3	adjusts "coarse" focus	adjusts high power objective	adjusts low power objective	adjusts "fine" focus
14	4	moves condenser	adjusts "fine" focus	adjusts "coarse" focus	moves slide
15	5	holds slide	focuses image	controls light reaching slide	directs light upwards
16	6	focuses light	controls light reaching slide	holds slide	light switch
17	7	focuses light on the object	magnifies light	controls field of view	moves slide
18	8	controls brightness	focuses light	holds slide	magnifies light
19	9	high power magnification	low power magnification	controls "coarse" focus	controls "fine" focus
20	10	high power magnification	low power magnification	controls "coarse" focus	controls "fine" focus

TEACHERS' NOTES

This test is designed to determine whether or not the student can name the parts of a monocular microscope and identify the functions of the parts.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1: This set is intended to measure familiarity with the names of the parts. A low score would suggest that the student may have difficulties following instructions on correct use of the microscope. Remedial drill may be indicated.

Set 2: This set is intended to determine whether the student understands the principles underlying his/her actions in using the microscope. This may not be essential in Years 7 and 8, but may well be necessary to students in Year 10 and proceeding to senior science.

Related tests: M46: Calculating microscope magnifications.

Related skills for which tests have not been prepared:

Using a microscrope.

M41

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SCIENCE

MASTERY TESTING PROGRAMME

A MASTERY TEST FOR THE SKILL OF CALCULATING DENSITY AND PREDICTING FLOTATION

10

This test is designed to measure your ability to work out relative densities and to predict what substances will float on another substance.

Set 1

The next five questions refer to this table.

SUBSTANCE	MASS (kg)	VOLUME (litres)
E	5	2
F	5	4
G	6	8
H	10	8
J	7	7

Choose the correct answer for each question given below, and mark its letter (A, B, C or D) on your answer sheet.

QUESTION	DESCRIPTION	POSSIBLE ANSWERS			
		A	B	C	D
1	The substance with a density of less than one.	E	F	G	H
2	The most dense substance.	E	G	H	J
3	The substance with density = 1.	F	G	H	J
4	Two substances with the same density.	E & F	E & G	F & H	G & H
5	The substance with a density of 2.5.	E	G	H	J

Set 2

This table gives the information needed for the next ten questions.

Liquid	Density
K	0.8
L	1.0
M	1.1
N	1.7
P	13.6

Solid	Density
Q	0.7
R	1.0
S	1.5
T	7.0
V	15.0

QUESTION	DESCRIPTION	POSSIBLE ANSWERS			
		A	B	C	D
6	A substance that will float on L:	K	M	S	T
7	A substance that will float on N:	P	S	T	V
8	A substance that S will float on:	K	L	M	N
9	A substance that will sink in N:	Q	R	S	T
10	A substance that will sink in M:	K	L	Q	S
11	A substance that will not sink or float in L:	K	M	R	S
12	A liquid in which both Q and S will float:	K	L	M	N
13	A liquid in which V and R will both sink:	K	M	N	P
14	A liquid in which R will float and S will sink:	K	L	M	N
15	A substance that will float on P and sink in N:	Q	S	T	V

TEACHERS' NOTES

This test is designed to determine whether or not the student can calculate density and apply the results in simple problem-solving.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as <80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1: Lack of familiarity with concept and/or definition of density; Simple errors in calculations.

Set 2: Lack of experience with problems on flotation; Lack of familiarity with the concept and/or principles of flotation; Simple errors in calculations.

Related skills for which tests have not been prepared:

Measurement and calculation of densities.
Flotation predictions with real objects.

M42

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SCIENCE

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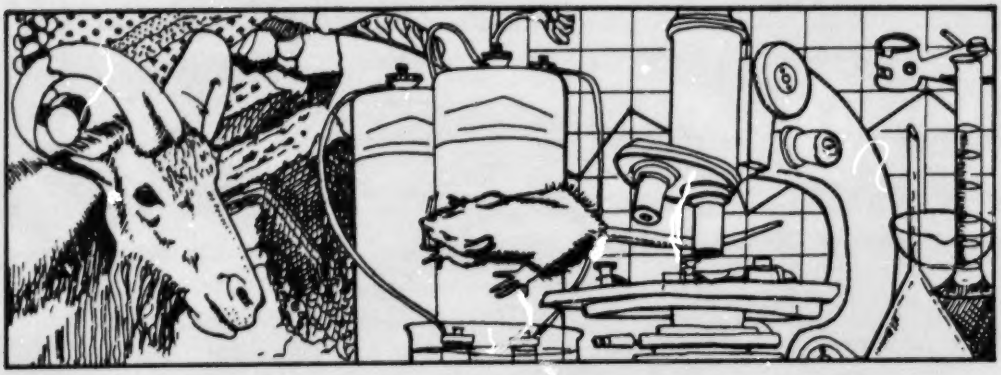

A MASTERY TEST FOR

THE SKILL OF
ESTIMATING METRIC LENGTH
(MILLIMETRES AND METRES)

This test is designed to test your ability to estimate size using S.I. units.

SET 1

The next five questions require you to estimate the length of a common object in *millimetres*. Make your own estimate, and choose the size nearest to that from the choices given. Mark the letter of that answer (A, B, C or D) on your answer sheet.

Question	Object	ANSWERS IN MILLIMETRES			
		A	B	C	D
1	match	20	50	100	150
2	height of large test tube	150	200	250	300
3	height of milk bottle	100	200	300	400
4	width of single door	200	400	600	800
5	height of door	1 000	1 500	2 000	2 500

SET 2

The instructions for the next five questions are the same as for Set 1, but the answers are in *metres*.

Question	Object	ANSWERS IN METRES			
		A	B	C	D
6	height of your school desk	1	2	3	4
7	height of the door of this room	1	1.5	2	2.5
8	height of this room	2	3	4	5
9	height of a "telegraph" pole	5	10	15	20
10	height of a ten storey building	10	20	30	40

SET 3

In the next ten questions, a size is given in *either* millimetres or metres. Choose the object which has that size as its BIGGEST MEASUREMENT. Mark its answer (A, B, C or D) on your answer sheet.

Question	Size	ANSWER OBJECTS			
		A	B	C	D
11	10 mm	diameter of a 1 cent coin	diameter of a 20 cent coin	length of a stick of chalk	height of a Bunsen burner
12	100 mm	diameter of a 50 cent coin	length of a stick of chalk	length of a ball point pen	length of a human foot
13	250 mm	length of an index finger	lab stool height	length of a human foot	length of elbow to finger tip
14	500 mm	lab stool height	door height	room height	"telegraph" pole height
15	1000 mm	width of hand	length of car	length of a baseball bat	length of a cricket pitch
16	0.5 metres	length of a fore-arm	length of a hockey stick	door height	door width
17	1 metre	length of a tennis racquet	length of a hockey stick	room height	length of a car
18	5 metres	height of double decker bus	length of a cricket pitch	length of a tennis court	length of a billiard table
19	10 metres	height of a 5 storey building	room height	length of a car	length of a bus
20	20 metres	length of a squash court	length of a football field	length of a cricket pitch	length of a hockey field

TEACHERS' NOTES

This test is designed to determine whether or not the student can estimate size in millimetres and metres.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1 Unfamiliarity with the length of a millimetre.
Problems with scaling up millimetres.
Unfamiliarity with the objects listed.

Set 2 Unfamiliarity with the length of a metre.
Problems with scaling up metres.
Unfamiliarity with some of the objects listed.

Set 3 Unfamiliarity with metric measurements.
Unfamiliarity with some items.

Related tests M58 Reading a linear scale.
M59 Converting metric length.

Related skills for which tests have not been prepared:

Estimating distance.
Measuring distances using different metric scales.

M43

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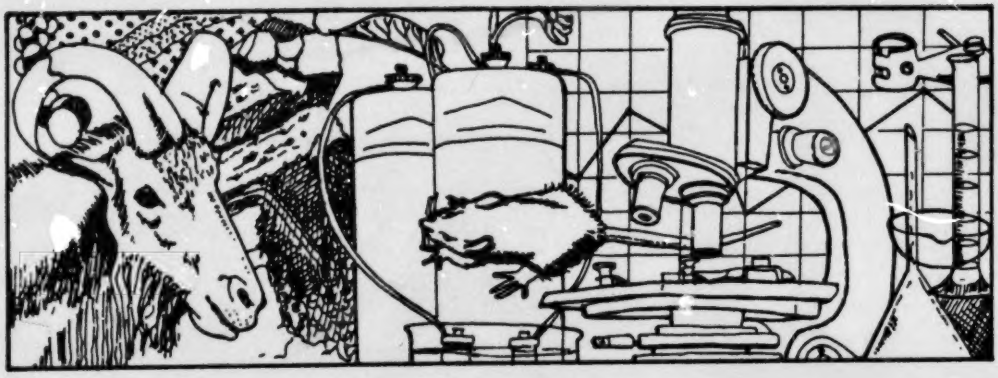

A MASTERY TEST FOR THE SKILL OF USING SI SYMBOLS

This test is designed to measure your ability to change units from words to symbols.

Use the following units and symbols to answer the questions.

UNIT	SYMBOL
metre	m
litre	L
second	s
minute	min
newton	N

UNIT	SYMBOL
millilitre	mL
gram	g
kilogram	kg
kilometre	km

You may need to know that "per" and "/" both mean "divided by". You may also need to know that "x.y" means "x multiplied by y".

SET 1

Choose the correct symbol for each unit and mark its letter (A, B, C or D) on your answer sheet.

Question	Unit	Possible Answers			
		A	B	C	D
1	metres per second	ms	m/s	m+s	m.s
2	newton metres	N.m	N/m	N+m	Nnm
3	kilometres per minute	km	km.min	km/min	km+min
4	litres per kilogram	L.kg	L.g	L+kg	L/kg
5	grams per second	g.s	s.g	s/g	g/s

SET 2

Choose the correct unit for each symbol and mark its letter (A, B, C or D) on your answer sheet.

Question	Symbol	Possible Answers			
		A	B	C	D
6	L/s	litres per second	second litre	litre ÷ seconds	litres second
7	m/km	metre kilometres	metres per kilometre	metres ÷ kilometres	millilitres per second
8	g/N	gram Newtons	grams per Newton	grams ÷ Newtons	Newton grams
9	N.s	Newtons	Newtons per second	Newtons ÷ seconds	Newton seconds
10	kg/min	kilometres per minute	kilogram per metre	kilograms per minute	kilograms minutes

SET 3

Choose the correct symbol for each unit and mark its letter (A, B, C or D) on your answer sheet.

Question	Unit	Possible Answers			
		A	B	C	D
11	kilogram × metre ÷ second	kg.m.s	kg/m.s	k/m/s	kg.m/s
12	metre ÷ second ÷ second	m/s.s	m.s/s	m/s^2	m.s.s
13	Newtons ÷ metres squared	$(N/m)^2$	N^2/m	$N.m^2$	N/m^2
14	litres × seconds × metres	L.s.m.	L/s/m	L÷s÷m	L/s.m
15	kilograms ÷ kilometre	kg.km	kg/km	Km/kg.m	km.kg

Usages in this test have been selected to conform with guidelines laid down by the Metric Conversion Board.

TEACHERS' NOTES

This test is designed to determine whether or not the student can select the correct symbols for various metric units

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1: Lack of familiarity with standard conventions of notation.

Problems in extracting information from the table (refer test M1).

Problems in converting from one code to another

(See "Using Codes" M39, M64 and trial 021072)

Set 2: As for set 1, with more emphasis on decoding

Set 3: As for set 1, but these items are more complex

Related Tests

M12: converting metric mass

M42: estimating metric length

M59: converting metric length

021017: converting metric volume

Related skills for which tests have not been prepared:

Writing units

Using units correctly in practical work.

M44

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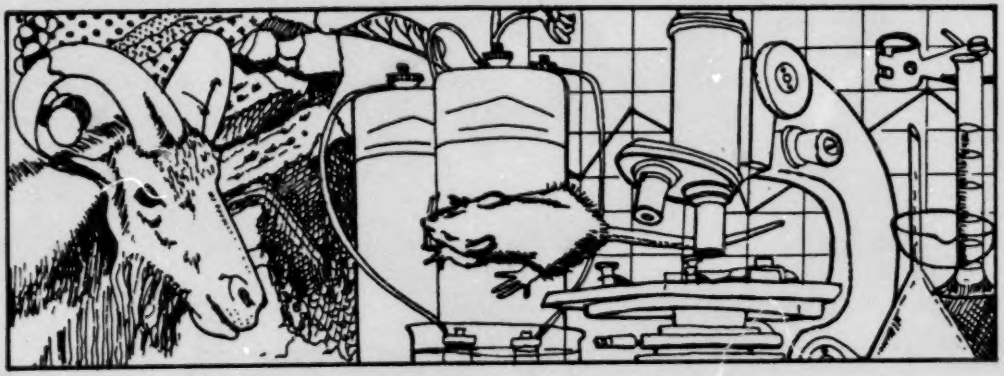


A MASTERY TEST FOR

THE SKILL OF

USING $s = vt$

This test is designed to measure your ability to apply the equation $s = vt$.

where s = distance in metres
v = velocity in metres/sec.
t = time in seconds.

SET 1

Choose the correct velocity for each question and mark its letter (A, B, C or D) on your answer sheet.

Question	Distance travelled (metres)	Time taken to travel distance (seconds)	Possible Velocities (m/s)			
			A	B	C	D
1	10	5	$\frac{5}{10}$	2	4	15
2	100	10	$\frac{1}{10}$	5	10	20
3	440	20	$\frac{1}{22}$	10	18	22
4	1000	50	$\frac{1}{50}$	$\frac{1}{20}$	15	20
5	1600	80	$\frac{1}{50}$	$\frac{1}{20}$	20	50

SET 2

Choose the correct distance a car would travel for each of the specific sets of information.

Question	Velocity (m/s)	Time (secs)	Possible Distances (m)			
			A	B	C	D
6	35	1.0	$\frac{1}{35}$	17	35	70
7	50	0.5	10	25	50	250
8	80	2.0	16	40	80	160
9	100	3.5	35	70	175	350
10	120	5.0	60	240	600	1200

SET 3

Choose the correct time it would take an object, to travel the distance s at velocity v given below.

Mark its letter (A, B, C or D) on your answer sheet.

Question	Distance (s) m	Velocity (v) m/s	Time (secs.)			
			A	B	C	D
11	100	200	$\frac{1}{2}$	2	100	200
12	100	300	$\frac{1}{30}$	$\frac{1}{3}$	3	300
13	$\frac{1}{2}$	200	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$	$\frac{1}{1000}$
14	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{5}{100}$	$\frac{1}{10}$	1	5
15	20	$\frac{1}{2}$	10	40	100	400

SET 4

This set is designed to identify problems which you may have shown in the first three sets. In each question, use the equation given for that question to find the correct answer, and mark its letter (A, B, C or D) on your answer sheet.

Question	Given Equation	Find	ANSWERS			
			A	B	C	D
16	$x = 2y$	y	2x	x	$\frac{x}{2}$	x^2
17	$y = \frac{x}{z}$	x	yz	$\frac{z}{y}$	$\frac{y}{z}$	y + z
18	$y = \frac{x}{z}$	z	$\frac{x}{y}$	$\frac{y}{x}$	xy	x + y
19	$x = yz$	y	$\frac{z}{x}$	$\frac{x}{z}$	xz	x + z
20	$x = yz$	z	$\frac{x}{y}$	$\frac{y}{x}$	xy	x + y

Strictly speaking, this test is incorrect. The word "velocity" should be replaced with "speed" whenever it appears, since s = vt is a scalar equation, and only scalar data are used.

Against this, the use of "v" for speed, and "s" for distance may cause confusion. It appears that the use of "s" for distance, while unsatisfactory, is entrenched, and must be accepted. This test is thus a compromise between practice and propriety.

All usages in this test have been selected to conform to guidelines laid down by the Metric Conversion Board.

TEACHERS' NOTES

This test is designed to determine whether or not the student can carry out simple calculations, on time, velocity and distance.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1: Problems in manipulating equation to change subject

Errors of substitution or calculation

Set 2: (Using the unaltered equation, placed second to avoid developing *response set* in students.)

Errors of substitution or calculation

Set 3: As for set 1

Set 4: Diagnostic set on changing subject of equation.

Items 19 and 20 are of particular relevance to Sets 1 and 3.

Related tests:

M18	Using Ohm's Law in calculations
M21	Calculating kinetic energy
M22	Using F = ma
M34	Interpreting ticker tapes
021045	Calculating from ticker tapes

Related skills for which tests have not been prepared:

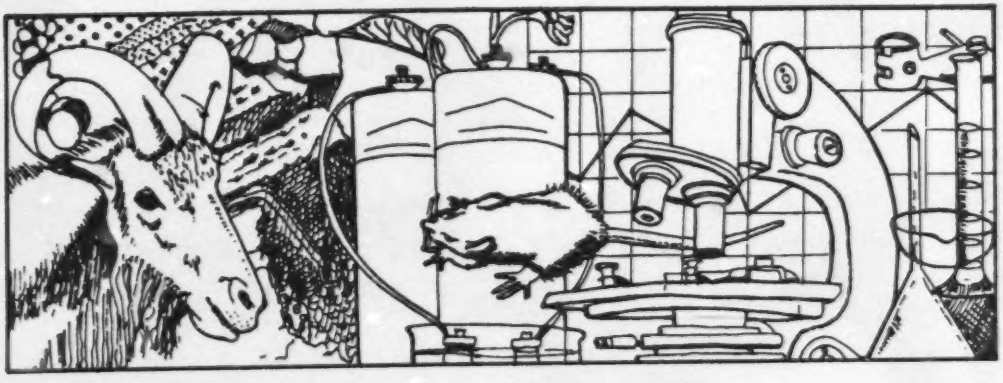
Measuring: distance, time, velocities.

M45

New South Wales **Department of Education**

SCIENCE

MASTERY TESTING PROGRAMME



A MASTERY TEST FOR

THE SKILL OF

APPLYING A NOVEL THEORY

This test is designed to measure your ability to understand and apply the knowledge in a scientific theory.

Read the theory below and then answer the questions which follow.

The Theory

Scientists on the planet Xenos have an atomic theory which is based on the assumption that an atom is composed of a central nucleus with negons arranged in successive orbits around it.

Each orbit, starting with the one closest to the nucleus, can hold a maximum number of negons as shown in the table.

Orbit Number	Max. No. negons in this orbit	Total number of negons if orbit full
1	3	3
2	6	9
3	12	21
4	18	39

The nucleus contains particles called plusons, in equal numbers to the negons in orbit. This number (the number of plusons in the nucleus) is also called the Reference number of each element.

Orbiting negons are arranged such that the first orbits fill up completely before a negon goes into a new orbit.

The stability of the atoms depends upon the number of negons in the orbit which is furthest from the nucleus - atoms with larger numbers of negons in their outside orbit are more stable than those with fewer negons.

SET 1

Choose the correct number of negons in the outside orbit of each atom and mark its letter (A, B, C or D) on your answer sheet.

Question	Total No. of negons possessed by atom in this question	No. negons in outside orbit of atom			
		A	B	C	D
1	4	1	2	3	4
2	7	1	3	4	6
3	9	2	3	5	6
4	12	1	3	4	6
5	27	3	5	6	9

SET 2

Choose the correct reference number for the atoms listed (6 - 10) and mark the letter (A, B, C or D) on your answer sheet.

Question	Number of orbits containing negons	No. of negons in outside orbit	Reference No.			
			A	B	C	D
6	1	1	1	2	3	4
7	2	4	4	7	9	10
8	3	7	7	9	16	19
9	4	5	5	12	17	26
10	5	10	10	22	28	49

SET 3

Choose the most stable atom and mark its letter (A, B, C or D) on your answer sheet.

Question	Total number of negons			
	A	B	C	D
11	1	2	3	4
12	6	7	8	9
13	9	10	11	12
14	20	21	22	23
15	7	16	26	33

SET 4

Choose the correct total number of negons for each atom and write its letter (A, B, C or D) on your answer sheet.

Question	Number of Orbits containing negons	Number of negons in last orbit	Possible Total Number of negons			
			A	B	C	D
16	1	2	1	2	3	4
17	2	3	3	5	6	9
18	3	4	10	13	21	25
19	4	5	17	23	26	44
20	5	6	24	30	45	63

TEACHERS' NOTES

This test is designed to determine whether or not the student can apply a complex and novel theory to solve problems.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as <80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems.

In each case, errors in a set will indicate either a misunderstanding of the "theory", a misapplication of the "theory", an attempt to apply the normal atomic theory to the problem, or a mathematical error.

Teachers may wish to set free response questions in each of the formats used in this test: a consideration of such responses would be indicative of the nature of a student's error.

Related tests: M49 Applying a theory of genetics
M51 Interpreting atomic numbers and mass numbers.

Related Skills for which tests have not been prepared

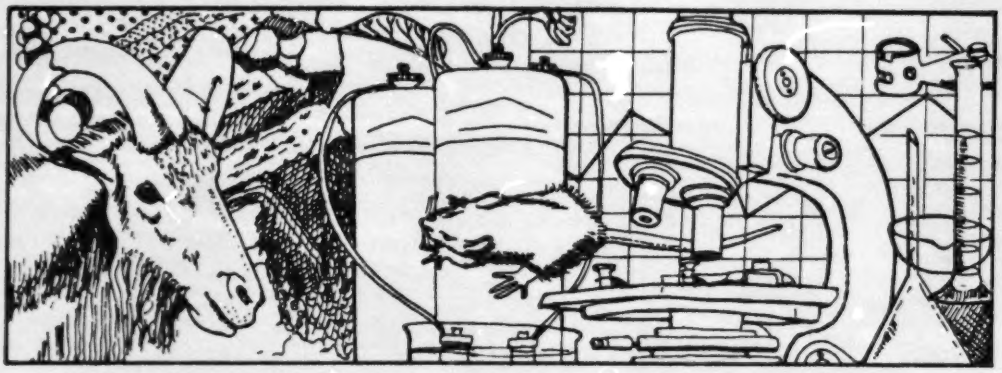
Formulating theories
Developing theories

M46

New South Wales **Department of Education**

SCIENCE

MASTERY TESTING PROGRAMME



A MASTERY TEST FOR THE SKILL OF CALCULATING MICROSCOPE MAGNIFICATIONS.

This test is designed to measure your ability to determine the magnification of a microscope. For each question choose the correct answer and write the letter (A,B,C or D) on your answer sheet.

SET 1: What magnification would you get if you were using a microscope with the following eyepiece and objective?

Ques.	Eyepiece	Objective	Magnification			
			A	B	C	D
1.	5	10	5	15	50	100
2.	5	40	8	35	45	200
3.	10	10	1	10	20	100
4.	10	20	20	30	200	210
5.	12.5	20	125	250	290	1200

SET 2: Which eyepiece and objective would you use to get the magnification indicated?

Ques.	Magnification	A		B		C		D	
		Obj.	Eye p.	Obj.	Eye p.	Obj.	Eye p.	Obj.	Eye p.
6.	40	×10	×4	×10	×8	×20	×20	×40	×10
7.	100	×10	×5	×10	×10	×50	×10	×20	×10
8.	200	×10	×12.5	×20	×10	×50	×5	×20	×20
9.	500	×10	×40	×25	×2	×50	×10	×100	×20
10.	1000	×40	×20	×50	×10	×50	×20	×100	×20

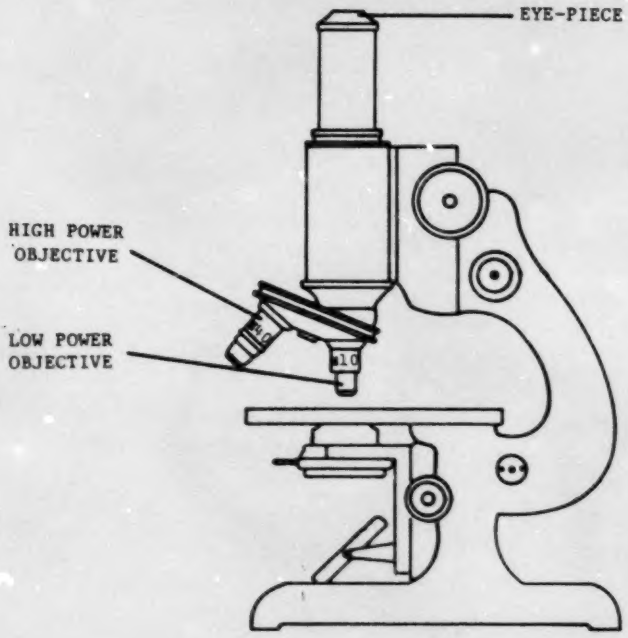
SET 3: A student using a microscope was observing using the magnification and eyepiece shown. What would be the new magnification if the eyepiece was changed to the value shown?

Ques.	Magnification used	Eye piece used	New Eye piece	New Magnification			
				A	B	C	D
11.	×100	×5	×10	50	150	200	1000
12.	×200	×10	×5	40	100	150	400
13.	×250	×12.5	×5	62.5	100	500	1000
14.	×400	×5	×20	800	1000	1200	1600
15.	×500	×10	×12.5	350	475	625	1250

SET 4: A student using a microscope used the magnification and eyepiece shown. If he wanted to use the new magnification, what new eyepiece would he use?

Ques.	Magnification used	Eye piece used	New magnification	New Eyepiece			
				A	B	C	D
16.	×100	×5	×200	×2.5	×10	×12.5	×20
17.	×200	×10	×600	×3	×25	×30	×40
18.	×250	×12.5	×100	×5	×10	×20	×25
19.	×500	×10	×750	×1.5	×2.5	×5	×15
20.	×1000	×20	×400	×2.5	×8	×20	×30

This test is one of a number of tests which may be used to determine readiness for a particular task. In this case the task is any form of biology requiring microscopy coupled to an understanding of scale.



TEACHERS' NOTES

This test is designed to determine whether or not the student can calculate the magnification of a microscope.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

. Difficulties in understanding the role of the eyepiece and objective in a microscope.

. Difficulties in performing the necessary calculations. TEACHERS MAY PREFER TO LEAVE SETS 3 AND 4 OUT WITH JUNIOR CLASSES.

Related tests:

M25 Manipulating equations
M40 Naming the parts of a microscope.

Related skills for which tests have not been prepared:

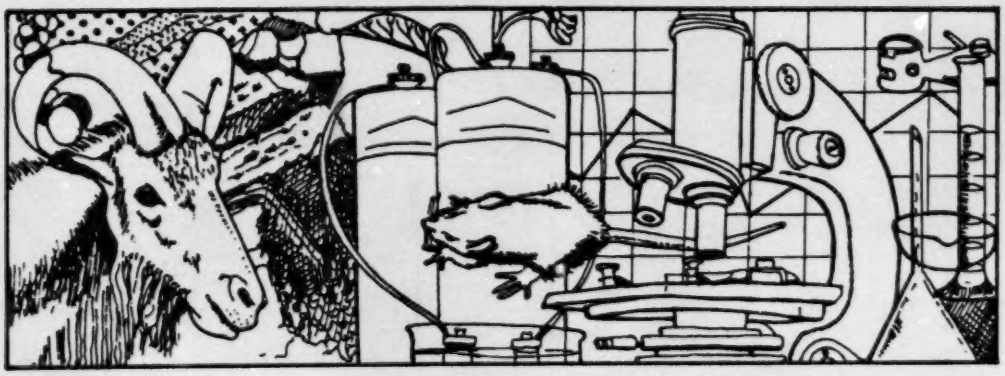
. Using a microscope.
. Preparing slides for use.
. Staining techniques.
. Simple multiplication, division.
. Structure and use of telescopes and other optical instruments.

M47

New South Wales **Department of Education**

SCIENCE

MASTERY TESTING PROGRAMME



A MASTERY TEST FOR

THE SKILL OF

IDENTIFYING TRENDS IN DATA

This test is designed to measure your ability to recognise trends in various aspects of Science.

For each question choose the correct answer and write the letter (A, B, C or D) on your answer sheet.

Examine the sets of data given in questions 1-5 and determine the missing quantity.

Question	Data		Possible Answers			
			A	B	C	D
	v	t				
1.	0	0				
	(?)	1				
	9	2	1	3	5	7
	27	3				
	81	4				
2.	(?)	1				
	4	2	0	1	2	3
	9	3				
	16	4				
3.	10	5				
	20	10				
	30	15	32	34	35	38
	(?)	16				
	40	20				
4.	0	0				
	5	1				
	15	2	40	45	50	55
	30	3				
	(?)	4				
5.	3	0				
	5	1				
	7	2	43	45	47	49
	9	3				
	(?)	20				

Set 2

Which is the correct missing formula for each space in the table?

Question	Data				Possible Answers			
					A	B	C	D
6.	CH_4	C_2H_6	?	C_4H_{10}	C_3H_6	C_3H_7	C_3H_8	C_3H_9
7.	C_2H_4	C_3H_6	C_4H_8	?	C_5H_{10}	C_5H_{12}	C_6H_{10}	C_6H_{12}
8.	C_2H_2	?	C_4H_6	C_5H_8	C_3H_3	C_3H_4	C_3H_5	C_3H_6
9.	C_6H_{12}	$C_6H_{10}Cl_2$	$C_6H_8Cl_4$	?	$C_6H_8Cl_4$	$C_6H_6Cl_6$	$C_6H_6Cl_2$	$C_6H_6Cl_8$
10.	CH_3CHO	?	C_3H_7CHO	C_4H_9CHO	HC_2CHO	C_2HCHO	C_2H_3CHO	C_2H_5CHO

WARNING! THIS SET IS MUCH HARDER!

Set 3 Successive ionisation energies of elements hydrogen to sodium in energy units.

Electrons-outermost to innermost

Element	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
H	300									
He	550	1 250								
Li	100	1 750	2 800							
Be	(P)	450	3 550	5 050						
B	200	600	900	6 000	7 850					
C	250	550	1 100	1 500	(R)	11 400				
N	350	700	1 100	1 800	2 250	12 700	(S)			
O	300	800	1 250	1 800	2 600	3 200	17 100	20 100		
F	400	800	1 450	2 000	2 650	3 600	4 250	22 000	25 300	
Ne	500	950	1 500	2 250	2 900	3 650	4 800	(T)	27 400	31 300
Na	100	1 100	1 650	(Q)	3 200	4 000	4 800	6 100	6 900	33 700

Question		Possible Answers			
		A	B	C	D
11.	P	100	150	200	250
12.	Q	1 400	1 800	2 100	2 400
13.	R	1 600	2 000	3 600	10 000
14.	S	10 000	12 000	15 000	18 000
15.	T	5 500	10 000	17 000	24 000

TEACHERS' NOTES

This test is designed to determine whether or not the student can detect trends in data which are new to the student.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1: Difficulties in recognising mathematical relationships.

Set 2: Unfamiliarity with chemical formulae.
Difficulties in recognising mathematical trends in organic formulae.

Set 3: Difficulties in reading from a table.
Unfamiliarity with correct metric usage for large numbers
(Q & S) Difficulties in extrapolating.
(Teachers should note that this is a *rounded-off* Kcal. table. It should not be used as a teaching aid.)

Related tests:

M6 Reading a line graph
M14 Calculating an average
M34 Interpreting ticker tapes
021095 Reading a graph by interpolation

Related skills for which tests have not been prepared:

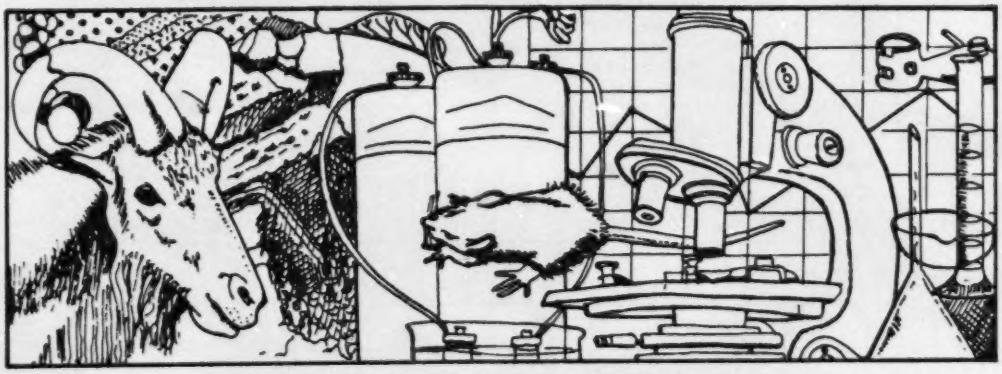
Detecting trends in graphs
Making predictions based on trends

M48

New South Wales **Department of Education**

SCIENCE

MASTERY TESTING PROGRAMME



A MASTERY TEST FOR THE SKILL OF CALCULATING AVERAGES IN PRACTICAL SITUATIONS

This test is designed to measure your ability to apply your knowledge of averages to some experimental situations. For each question choose the correct answer and write the letter (A,B,C, or D) on your answer sheet.

SET 1

Question	Experiment	A	B	C	D
1	3 students each measured the mass of a rock and found it to be 6.0, 6.1 and 6.2 grams. What is the average mass of the rock?	6.0	6.1	6.15	6.2
2.	The volume of a rock was measured by 2 students and found to be 16.0 mL and 16.2 mL. What was the average volume?	16.0	16.1	16.15	16.2
3.	4 students found the diameter of a filter paper to be 10, 10.1, 10.2 and 10.4 cm. The average diameter of the paper is nearest to	10.0	10.1	10.2	10.3
4.	The time taken for a cylinder to fill from a dripping tap was found to be 36,37,38 and 39 seconds by 4 students. The average time is closest to	36.5	37.0	37.5	38.0
5.	The mass of a collision trolley was found to be 1000 g, 1010 g, 1026 g by 3 students. The average mass of the trolley is	1009	1012	1015	1018

SET 2

Question	Experiment	A	B	C	D
6.	If 10 matches have a mass of 2.3 grams, then the mass of 1 match is nearest (in grams) to	0.23	2.3	12.3	2.3
7.	A student added 6 tubes of water to a measuring cylinder and filled it to the 90 mL mark. The average volume of the tube is (in mL).	6	12	15	18
8.	If a student timed 30 drops from a dripping tap in 2 minutes, then the average time between drops is (in secs)	1	2	3	4
9.	If 11 drops of water have a volume of 10mL, then the volume of one drop is nearest (in mL)to	0.9	1.0	1.1	2
10.	50 spoonsful of water were needed to fill a 250 mL beaker. The volume of one spoonful (in mL) is nearest to	2.5	5	10	15

SET 3

Question	Experiment	A	B	C	D
11.	The average mass of two brass cubes is 50g, and one has a mass of 49.8g. The mass of the other is nearest (in grams) to	0.2	49.9	50.1	50.2
12.	A student measured 3 lengths of wire and found the average length to be 5.0 cm. He found 2 lengths to be equal at 5.1 cm. The third (in cm) is nearest to	4.8	4.85	4.9	5.0
13.	If the average volume of three test tubes is 16mL, and the smallest has a volume of 14mL, then the largest would have a volume (in mL) of	15	16	16.5	17
14.	Students were told that the average mass of 6 rocks was 56 grams. If 5 of the masses total 286 grams, then the mass of the 6th rock (in grams) is nearest to	48	50	53	56
15.	The average height of three students was found to be 150 cm. If the tallest was 160 cm, then the shortest could be	120	125	144	150

N.B.: All usages in this test have been chosen to conform with guidelines laid down by the Metric Conversion Board.

TEACHERS NOTES

This test is designed to determine whether or not the student can calculate averages in a concrete situation.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Sets 1, 2 and 3:	Problems in using decimal notation Lack of familiarity with conventions of calculating averages (Test M14 includes basic diagnostic features) Problems with comprehension of question stems (See "Readability and Science Testing" and Comprehension Testing Programme).
Sets 2 and 3:	Difficulties in making deductive conclusions.
Set 3:	Difficulties with "reverse deductions".

Related Tests:

M14 Calculating an average

Related skills for which tests have not been prepared:

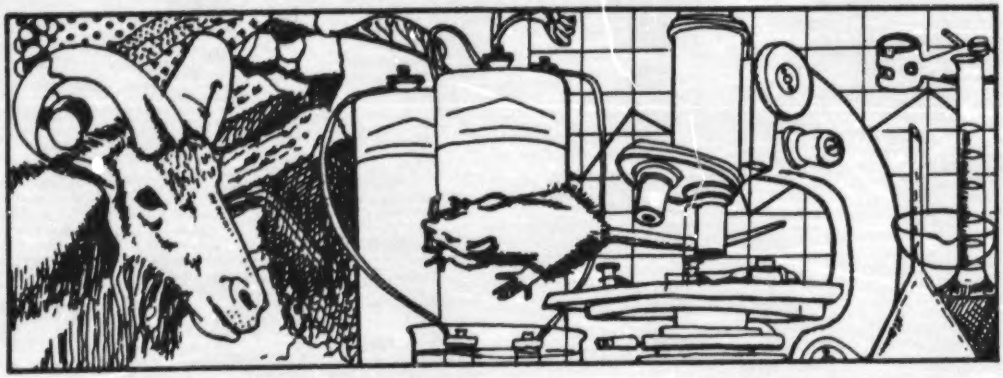
Calculating an average without the cues and clues afforded by the multiple choice format.

M49

New South Wales **Department of Education**

SCIENCE

MASTERY TESTING PROGRAMME



A MASTERY TEST FOR
THE SKILL OF
APPLYING A
THEORY OF GENETICS

This test is designed to measure your ability to apply a theory of genetics to an example. For each question choose the correct answer and write the letter (A, B, C or D) on your answer sheet. The questions refer to this information:

Scientists on the planet Xenos studied the genetics of an animal which they called an XINSECT.

They observed that characteristics of the XINSECT were either DOMINANT (if present, they always appeared in offspring) or RECESSIVE (only appeared if both parents had them).

They listed the following characteristics, and the symbols they decided to use for the characteristics.

CHARACTERISTIC	DOMINANT	SYMBOL	RECESSIVE	SYMBOL
wing pattern	plain	W	spotted	w
antennae	straight	A	curly	a
eye colour	black	E	white	e
eye shape	round	R	square	r
wing size	large	S	small	s
body pattern	striped	P	plain	p
body shape	chunky	B	slender	b
stinger	yes	T	no	t
body covering	fur	F	plain	f
number of wings	4	N	2	n

Set 1: For questions 1-5, choose the most likely characteristics (in symbol form) for an offspring of the parents shown.

Q	MALE PARENT	FEMALE PARENT	POSSIBLE OFFSPRING			
			A	B	C	D
1.	WER	wer	WER	Wer	WEr	WeR
2.	ASp	aSp	ASP	ASp	Asp	aSP
3.	ePb	epb	EPB	EPb	ePb	epb
4.	tfn	tfn	TFN	tfN	tFn	tfn
5.	rbf	RBf	RBF	RBf	rbF	Rbf

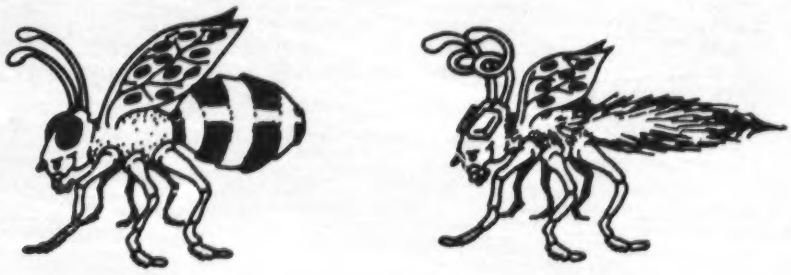
Set 2: For each question (6-10) choose the most probable offspring from mating the parent Xinsects shown.

Q	MALE PARENT	FEMALE PARENT	POSSIBLE OFFSPRING			
			A	B	C	D
6.	plain wings straight antennae white eyes	spotted wings curly antennae black eyes	plain straight black	plain curly white	plain curly black	spotted straight white
7.	plain wings small wings slender body	plain wings large wings slender body	plain large chunky	plain large slender	spotted small slender	spotted large slender

Set 2 (Continued)

Q	MALE PARENT	FEMALE PARENT	POSSIBLE OFFSPRING			
			A	B	C	D
8.	striped body chunky body stinger	plain body slender body no stinger	plain slender no stinger	plain slender stinger	plain chunky stinger	striped chunky stinger
9.	black eyes square eyes no fur	black eyes round eyes fur	black square fur	black square no fur	black round fur	black round no fur
10.	spotted wings straight antennae plain body	plain wings curly antennae plain body	plain straight plain	plain straight striped	spotted straight plain	plain curly striped

Set 3 Here are two parent Xinsects. Both are pure-breeding.



For questions 11-15, choose the characteristics which could be present in the offspring of the two Xinsects shown above.

Q	CHARACTERISTICS	POSSIBLE OFFSPRING			
		A	B	C	D
11.	wing pattern antennae	plain straight	plain curly	spotted straight	spotted curly
12.	eye colour eye shape	black round	black square	white round	white square
13.	wing size body pattern	small plain	small striped	large plain	large striped
14.	body shape stinger	chunky yes	chunky no	slender yes	slender no
15.	body covering number of wings	plain 2	plain 4	fur 2	fur 4

TEACHERS' NOTES

This test is designed to determine whether or not the student can manipulate complex information on Mendelian inheritance.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Misunderstanding of tabulated information.

Incorrect translation from word, symbol and diagram form.

Related tests

021056 Completing a genetic table.

Related skills for which tests have not been prepared:

Developing a theory of genetics

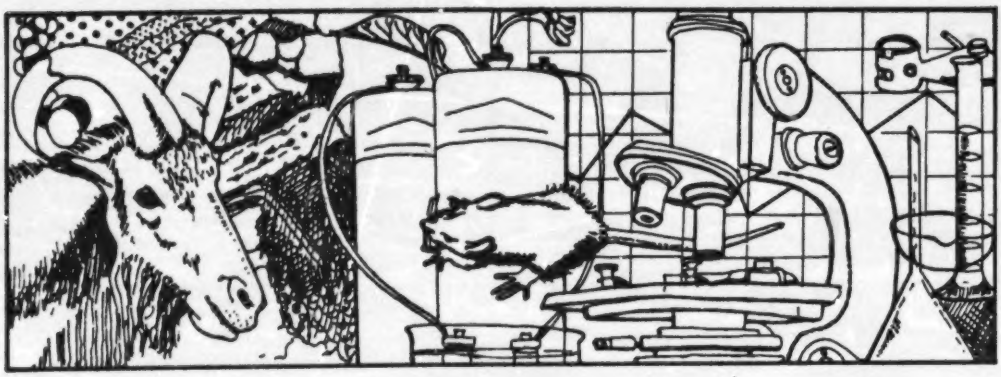
Manipulative skills with mice, *Drosophila* etc.

M50

New South Wales **Department of Education**

SCIENCE

MASTERY TESTING PROGRAMME



A MASTERY TEST FOR THE SKILL OF MULTIPLYING IN SCIENTIFIC NOTATION

This test is designed to measure your ability to multiply numbers written in powers of ten.
For each question select the correct answer and write its letter (A,B,C or D) on your answer sheet.

SET 1

Question	Problem	A	B	C	D
1.	$1 \times 10^3 \times 1 \times 10^3$	1×10^6	2×10^6	1×10^9	2×10^9
2.	$1 \times 10^3 \times 2 \times 10^2$	2×10^5	3×10^5	2×10^6	3×10^6
3.	$2 \times 10^1 \times 3 \times 10^4$	5×10^4	6×10^4	5×10^5	6×10^5
4.	$3 \times 10^2 \times 3 \times 10^5$	6×10^7	9×10^7	6×10^{10}	9×10^{10}
5.	$4 \times 10^2 \times 2 \times 10^4$	6×10^6	8×10^6	6×10^8	8×10^8

SET 2

Question	Problem	A	B	C	D
6.	$9 \times 10^{-3} \times 9 \times 10^4$	18×10^{-12}	81×10^{-12}	8.1×10^{-3}	1.8×10^4
7.	$8 \times 10^{-6} \times 9 \times 10^4$	7.2×10^{-1}	1.7×10^2	17×10^{10}	72×10^{10}
8.	$6 \times 10^{-4} \times 7 \times 10^5$	42×10^{-9}	13×10^{-1}	4.2×10^2	1.3×10^9
9.	$4 \times 10^{-3} \times 5 \times 10^6$	20×10^{-18}	9×10^{-9}	9×10^3	2×10^4
10.	$4 \times 10^{-2} \times 3 \times 10^7$	12×10^{-14}	1.2×10^5	1.2×10^6	7×10^9

SET 3

Question	Problem	A	B	C	D
11.	$2 \times 10^{-2} \times 3 \times 10^{-7}$	5×10^{-14}	6×10^{-14}	5×10^{-9}	6×10^{-9}
12.	$8 \times 10^4 \times 9 \times 10^{-6}$	7.2×10^{-24}	1.7×10^{-24}	17×10^{-2}	7.2×10^{-1}
13.	$10 \times 10^{-7} \times 10 \times 10^3$	100×10^{-21}	2.0×10^{-20}	20×10^{-4}	1.0×10^{-2}
14.	$15 \times 10^{10} \times 3 \times 10^{-20}$	4.5×10^{-1}	18×10^{-2}	45×10^2	18×10^2
15.	$20 \times 10^{10} \times 3 \times 10^{-22}$	23×10^{-22}	60×10^{-22}	6.0×10^{-11}	23×10^2

SET 4

Question	Problem	A	B	C	D
16.	$2 \times 10^{-3} \times 3 \times 10^{-3}$	5×10^{-6}	6×10^{-6}	5×10^{-9}	6×10^{-9}
17.	$3 \times 10^{-3} \times 4 \times 10^{-6}$	1.2×10^{-8}	7×10^{-9}	12×10^{9}	12×10^{18}
18.	$4 \times 10^{-3} \times 6 \times 10^{-8}$	24×10^{-5}	2.4×10^{-10}	10×10^{-11}	1.0×10^{-12}
19.	$7 \times 10^{-6} \times 8 \times 10^{-7}$	15×10^{-1}	5.6×10^{-12}	5.6×10^{-42}	56×10^{42}
20.	$10 \times 10^{-5} \times 10 \times 10^{-5}$	100×10^{0}	1.0×10^{2}	20×10^{-5}	1×10^{-8}

TEACHERS' NOTES

This test is designed to determine whether or not the student can multiply numbers written in scientific notation.

This test has been tested on a range of students in Years 7 to 10 in New South Wales schools.

Recommended mastery score:

The final decision as to the score which indicates mastery must lie with the classroom teacher, but *in general it should not be more than 80%* (8 out of 10, 12 out of 15, or 16 out of 20). The most important question to ask is: if the test has sets, did the student do poorly on one or more sets? "Poorly" here would usually be taken as<80% (4 out of 5 or 8 out of 10). It is for this reason that the cumulative percentages shown in earlier tests have been dropped for tests after M38.

Proper use of the scores:

This test is not designed to rank or grade students and its use for this purpose is highly undesirable. The scores obtained on this test will supply information about students who are having difficulty with the skill tested. For a more detailed analysis of these points, consult the manual which accompanies these tests.

Set scores:

Low scores on certain sets of questions may indicate specific problems as indicated below:

Set 1: Misunderstanding of meaning of numbers in scientific notation
Set 2: (Misunderstanding of meaning of negative
Set 3: (indices. Problems with manipulating
Set 4: (powers of 10.

Related tests:

M31: Using scientific notation Part 1*
M24: Using scientific notation Part 2*
M37: Dividing in scientific notation.

* Problems in carrying out trials resulted in test 2 being released earlier.

This test is intended to be used as a readiness test before commencing a science unit which requires this mathematical skill. Teachers may prefer to allow their students to use calculators, or even to work in groups.